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❑ Motivation:

To suppress the localized or impurity charge carriers at the interface of $SrTiO_3$-based 2DEGs by introducing an electron sink. Perovskite manganites are good candidates due to the good lattice match with STO and the presence of empty or partially-filled band lower than that of STO.

❑ Metallic oxide interfaces with extremely-high electron mobility and controllable carrier density

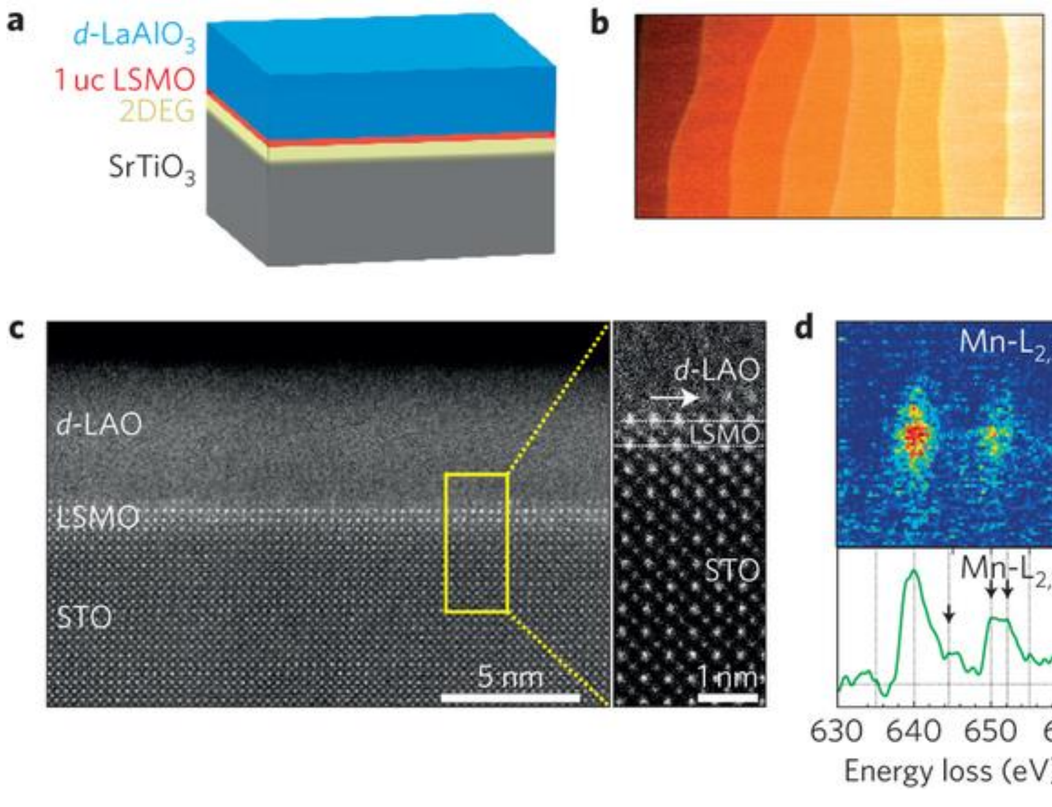

Fig. 1. Oxide interfaces with a single-unit-cell manganite buffer layer

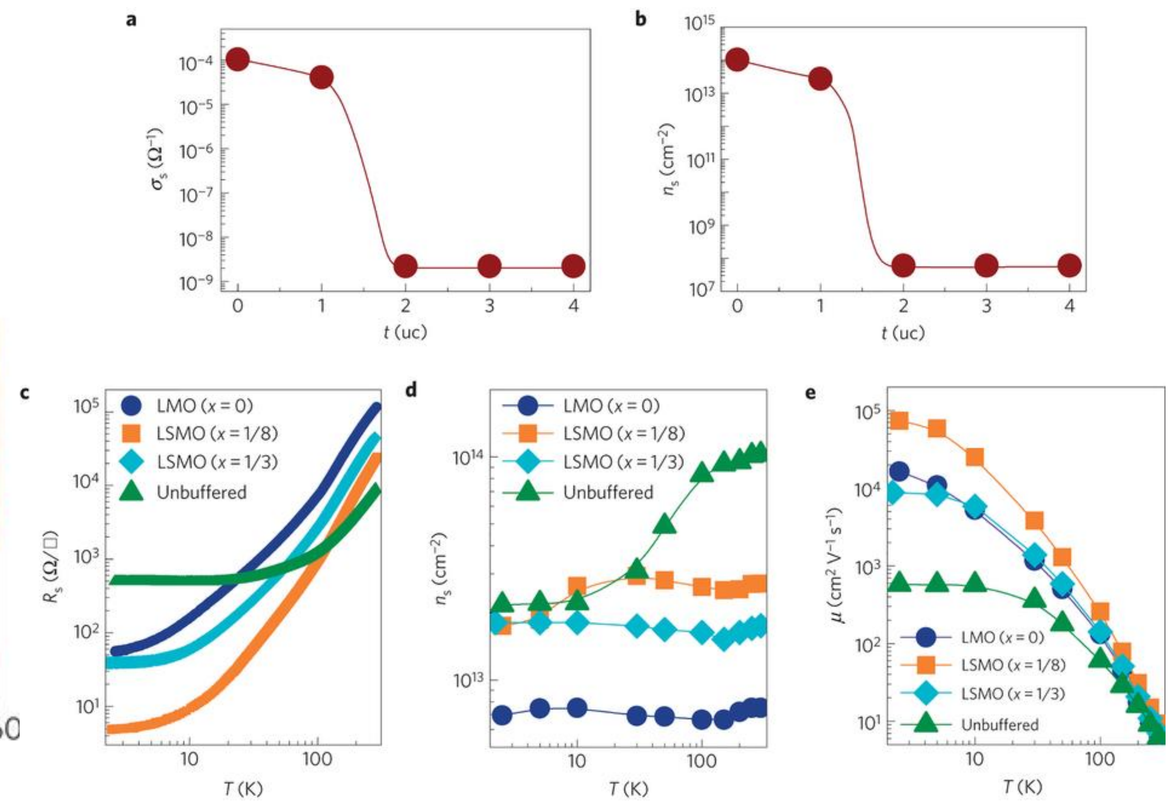

Fig.2. Electronic properties of buffered heterostructures

❑ Charge transfer induced modulation-doping at oxide interfaces

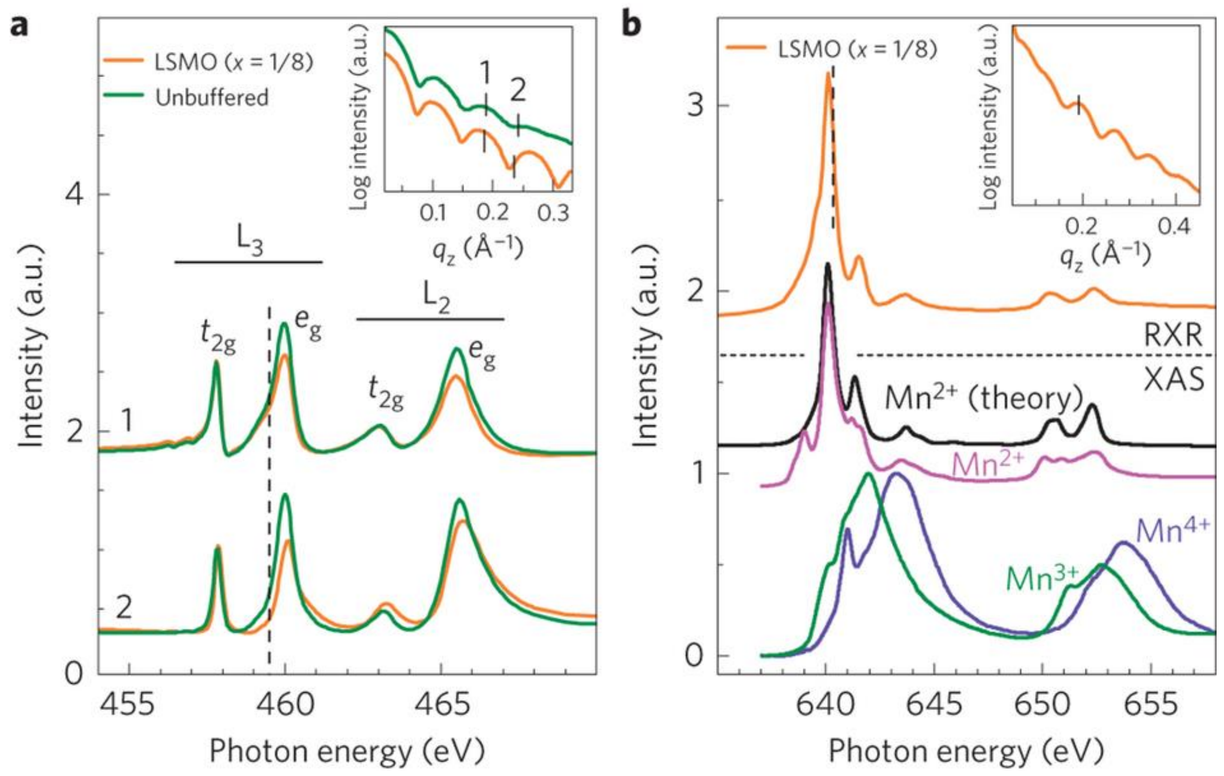

Fig.3. Electronic reconstructions determined by resonant X-ray reflectivity.

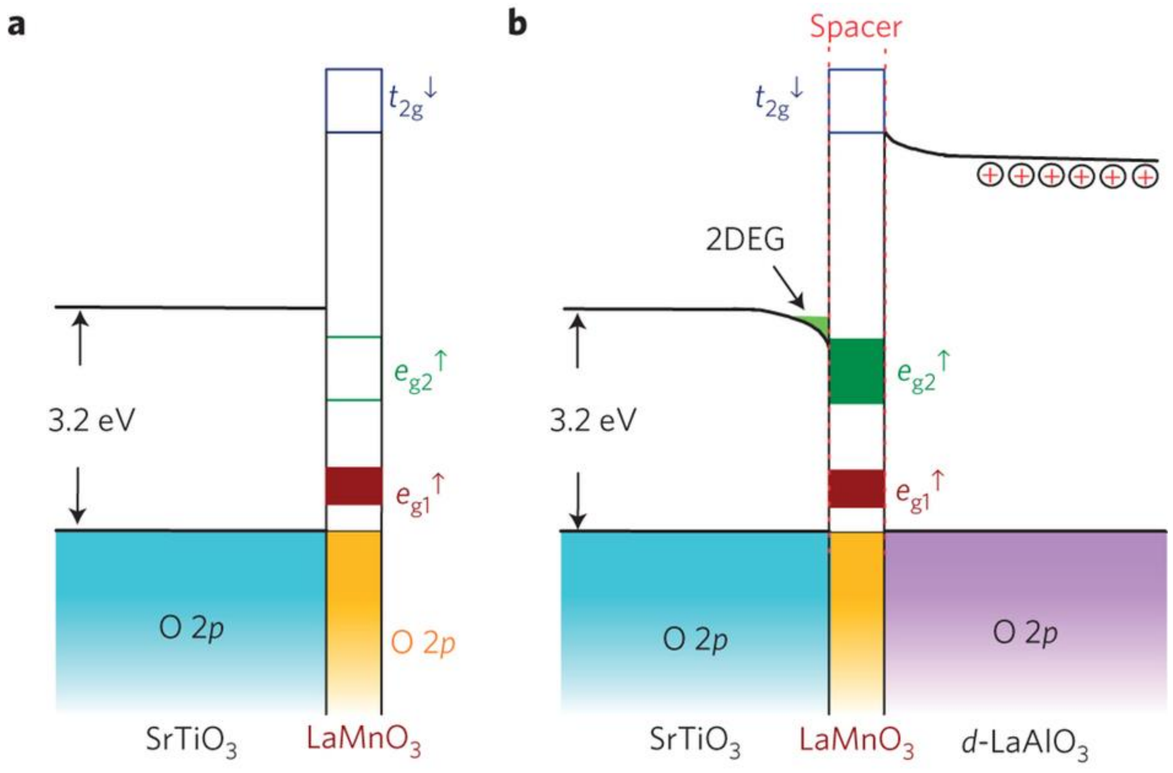

Fig. 4 Schematic band diagram of LMO/STO and buffered *d*-LAO/STO

❑ Conclusion

The manganite spacer suppresses strongly the formation of oxygen vacancies on the STO side and leads to modulation-doping at the buffered oxide interface. At low temperatures, the modulation-doped 2DEG exhibits clear Shubnikov-de Haas oscillations and clear quantum Hall effect.

1) Y. Z. Chen *et al. Nano Lett.*, **11**, 3774-3778 (2011); **2)** Y. Z. Chen *et al. Nature Mater.* **14,** 801-806 (2015)
3) **News story: Clean up metallic oxide interfaces** (nanotechweb.org)